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(21)Application number : 2000-243115 (71)Applicant : SHARP CORP

(22)Date of filing : 10.08.2000 (72)Inventor : FUJITA YOSHIMASA

(54) ORGANIC EL LAYER COATING FLUID, ORGANIC EL ELEMENT AND MANUFACTURING METHOD OF THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an organic EL element (a pixel) and an organic EL display enabled to display in monochrome and in color.

SOLUTION: The organic EL layer coating fluid to be used for the formation of the organic EL element, contains a leveling agent and a luminous material or an electric charge transport material, and the added volume of the leveling agent (L) fulfills the relation expressed so that the viscosity of L (cp) × the volume of the leveling agent L added to the luminous material or the electric charge transport material in (wt.%)<200.

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CLAIMS

[Claim(s)]

[Claim 1]It is coating liquid for organic electroluminescence layer formation used when forming an organic layer of an organic EL device, Coating liquid for organic electroluminescence layer formation, wherein said coating liquid contains a leveling agent, a luminescent material, or a charge transporting material and an addition of said leveling agent (L) fills an expression of relations expressed with addition (wt%) <200 of L to a viscosity (cp) x luminescent material or a charge transporting material of L.

[Claim 2]The coating liquid for organic electroluminescence layer formation according to claim 1 in which steam pressure at temperature at the time of forming an organic layer contains a solvent which is 500 Pa or less.

[Claim 3]A manufacturing method of an organic EL device characterized by forming an organic layer of an organic EL device by the ink jet method or print processes using the coating liquid for organic electroluminescence layer formation according to claim 1 or 2.

[Claim 4]An organic EL device, wherein at least one layer of an organic layer of an organic EL device contains a leveling agent which is formed using the coating liquid for organic electroluminescence layer formation according to claim 1 or 2, and consists of a silicon system compound or a fluorine system compound.

[Claim 5]The organic EL device according to claim 4 which has a septum with critical surface tension smaller than surface tension of coating liquid for organic electroluminescence layer formation.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the coating liquid for organic electroluminescence layer formation for manufacturing the organic EL device (pixel) and organic electroluminescence display in which monochrome and a full color display are possible, the organic EL device using it, an organic electroluminescence display, and its manufacturing method.

[0002]

[Description of the Prior Art]In recent years, while the requests to a thin shape, low power consumption, and a lightweight display device mount with high advancement in information technology, the low voltage drive and the high-intensity organic electroluminescence display attract attention. By research and development in recent years, the improvement in the luminous efficiency of the organic EL device using an organic (polymers) system material especially is remarkable, and the utilization to an organic electroluminescence display has started.

[0003]Since the polymer material can form membranes by wet process by spreading in manufacturing an organic electroluminescence display, it counts upon low cost-ization, The patterning method of the luminous layer towards colorization is 1 ** for the purpose of [important] research, Patternizing of the luminous layer by the ink jet method (JP,10-12377,A and ICPA'99, p160) and print processes (JP,3-269995,A and JP,11-273859,A) is reported.

[0004]

[Problem(s) to be Solved by the Invention]However, in the organic electroluminescence display produced by the ink jet method and print processes, since it was difficult for the surface to form a smooth film, the problem that emission unevenness arose or luminous efficiency and a life fell compared with the film formed by the spin coat method had arisen.

[0005]The constituent (coating liquid) used for them when manufacturing an organic EL device in JP,11-40358,A and JP,11-54270,A by the ink jet method is indicated, and it is indicated that a leveling agent may be added to the coating liquid. However, there is no statement of the example of the coating liquid which added the leveling agent concretely in these gazettes, and there is also no illustration of the leveling agent in them.

[0006]

[Means for Solving the Problem]In view of the above-mentioned problem, accomplish this invention, and The ink jet method, A result of having inquired wholeheartedly in order to cancel decline in emission unevenness resulting from the surface smoothness of a film produced when a film is formed by print processes, and luminous efficiency, By making a leveling agent which consists of a leveling agent especially a silicon system compound, or a fluorine system compound of a specific amount contain, it finds out that a technical problem of the above also unexpectedly is cancelable, and came to complete this invention.

[0007]Coating liquid for organic electroluminescence layer formation containing a leveling agent which consists of a leveling agent especially a silicon system compound, or a fluorine system compound of a specific amount is used into coating liquid like this invention, By the ink jet method or print processes, by forming an organic layer of at least one layer in an organic EL device, A fall of a luminescent characteristic and a life resulting from content of a leveling agent is not caused, It becomes possible to solve a problem of emission unevenness which it becomes possible to form a film which has the flat surface, and originates in membranous surface smoothness as a result arising, or falling compared with a film in which luminous efficiency and a life were formed by a spin coat method.

[0008]

[Embodiment of the Invention]Hereafter, the suitable embodiment of this invention is described with reference to drawings. As an organic EL device (pixel), as shown in drawing 1, it consists of the 1st electrode 2, the organic electroluminescence medium 3, and the 2nd electrode 4 on the substrate 1 at least. Here, it is preferred that the septum 5 is formed in the side attachment wall of the organic electroluminescence medium 3 and the 2nd electrode 4. It is preferred that the deflection plate 7 is formed in the outside of the substrate 1 from a viewpoint of contrast, and it is preferred that the sealing film or the sealing substrate 6 is further formed on the 2nd electrode 4 from a viewpoint of reliability.

[0009]As a substrate, although it is usable in resin substrates, such as inorganic material boards, such as a quartz substrate and a glass substrate, and a polyethylene terephthalate board, a polyether sulphone board, and a polyimide substrate, this invention is not limited to these.

[0010]An organic electroluminescence medium may be the structure of having an organic luminous layer of at least one layer, and may be the layer structure of an organic luminous layer, or the multilayer structure of a charge transport layer (an electron transport layer and an electron hole transporting bed) and an organic luminous layer. Here, a charge transport layer and an organic luminous layer may be multilayer structure, respectively. A buffer layer may be provided between a luminous layer and an electrode if needed. The organic layer in this invention means the organic luminous layer and charge transport layer which constitute an organic electroluminescence medium.

[0011]The coating liquid for organic electroluminescence layer formation according [at least one layer] to this invention is used for an organic electroluminescence medium, Although it is preferred to be formed of the ink jet method or print processes, the layer of others [case / of multilayer structure] may be formed by the method of this invention, and may be formed by a conventional method like dry processes, such as dry processes, such as a vacuum deposition method, a dip coating method, a spin coat method, for

example.

[0012]Next, the coating liquid for organic electroluminescence layer formation of this invention is explained. The coating liquid for organic electroluminescence layer formation of this invention can be divided roughly into the coating liquid for luminous layer formation, and the coating liquid for charge transport layers.

[0013]The coating liquid for luminous layer formation makes a solvent dissolve or distribute a luminescent material and leveling agents, such as material having contained both the precursor of the publicly known low molecule luminescent material, high polymer luminescent material, and high polymer luminescent material which are used for organic EL device formation, or a low molecule luminescent material and a polymer material. Although each material is illustrated below, these do not limit this invention.

[0014]As a publicly known low molecule luminescent material, triphenylbutadiene, a coumarin, the Nile red, an oxadiazole derivative, a chelate complex, etc. are mentioned, for example. As a publicly known high polymer luminescent material, for example Poly (2-decyloxy 1,4-phenylene) [DO-PPP], Poly[2,5-screw {2-(N,N,N-triethyl ammonium) ethoxy}-1,4-phenylene-alto 1,4-phenylene] dibromide [PPP-NEt₃⁺], The poly [2-(2'-ethylhexyloxy)-5-methoxy- 1, 4-phenylenevinylene], [MEH-PPV], Poly [5-methoxy (2-pro PANOKI sisal FONIDO)-1,4-phenylenevinylene], [MPS-PPV], Poly [2,5-bis(hexyloxy 1,4-phenylene)(1-cyanovinylene)], [CN-PPV], Poly [2-(2'-ethylhexyloxy)-5-methoxy-1,4-phenylene-(1-cyanovinylene)], [MEH-CN-PPV], poly (dioctylfluorene) (PDF), etc. are mentioned.

[0015]As a precursor of a publicly known high polymer luminescent material, a poly (p-phenylene) precursor [Pre-PPP], a poly (p-phenylenevinylene) precursor [Pre-PPV], a poly (p-naphthalene vinylene) precursor [Pre-PNV], etc. are mentioned, for example. As a publicly known polymer material, polycarbonate (PC), polymethylmethacrylate (PMMA), polycarbazole (PVCz), etc. are mentioned, for example.

[0016]As a leveling agent, a silicon system compound, a fluorine system compound, a non-ion system surface-active agent, an ion system surface-active agent, a titanate coupling agent, etc. can be used, and a silicon system compound and a fluorine system compound are especially preferred. As a silicon system compound, dimethyl silicone, methyl silicone, Phenyl silicone, methylphenyl silicone, alkyl modification silicone, alkoxy denaturation silicone, polyether denaturation silicone, etc. are mentioned, and dimethyl silicone and methylphenyl silicone are especially preferred. As a fluorine system compound, polytetrafluoroethylene, polyvinylidene fluoride, fluoro alkyl methacrylate, perfluoro polyether, perfluoroalkyl ethylene oxide, etc. are mentioned, and polytetrafluoroethylene is especially preferred. More specifically as a leveling agent, the dimethylsiloxane compound made from Shin-etsu Silicone (trade name: KF96L-1, KF96L-5, KF96L-10, KF96L-100) can be used conveniently.

[0017]As for the addition of a leveling agent (L), it is preferred to fill the expression of relations expressed with addition (wt%) <200 of L to the viscosity (cp) x luminescent material of L. Usually, the addition of a leveling agent is 0.0001 - 30wt% to a luminescent material, is 0.001 - 10wt% preferably, and is 0.1 - 5wt% more preferably.

[0018]It is preferred to use the solvent in which the steam pressure at the temperature at the time (at the time of transfer) of forming an organic layer contains at least one kind of solvent which is 500 Pa or less as a solvent used in order to dissolve or distribute a

luminescent material which was mentioned above. In order to realize still more preferably the viewpoint of membranous surface nature, and thickness which was suitable as an organic EL device, especially the solvent whose steam pressure is 250 Pa or less is preferred. the solvent whose steam pressure is 500 Pa or less when using the mixed solvent of two or more kinds of different solvents -- more than 50wt% -- containing is preferred. In forming the organic electroluminescence medium which consists of a multilayer cascade screen, in order to prevent mixing of the material between the touching films, the solvent used for the layer formed behind has that preferred in which the layer currently formed previously is not dissolved.

[0019]As a solvent which is 500 Pa or less, the steam pressure at the temperature at the time of forming an organic layer, For example, ethylene glycol, propylene glycol, triethylene glycol, Ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, Triethylene glycol monomethyl ether, triethylene glycol monoethyl ether, Glycerin, N,N-dimethylformamide, N-methyl-2-pyrrolidone, Cyclohexanone, methanol, ethanol, 1-propanol, octane, nonane, Deccan, xylene, diethylbenzene, trimethyl benzene, nitrobenzene, etc. are mentioned, and these solvents can also be used as a mixed solvent which combined two or more sorts.

[0020]To the coating liquid for luminous layer formation, if needed The additive agent;N,N-bis-(3-methylphenyl)-N,N'-bis(phenyl)benzidine for viscosity control [TPD], Objects for organic electroluminescence, such as N,N'-JI (naphthalene-1-yl)-N,N'-diphenyl-benzidine [NPD], or the publicly known hole transporting material for organic photo conductors; 3-(4-biphenyl)-4-phenylene-5-t-butylphenyl 1,2,4-triazole [TAZ], Electron transport materials, such as tris(8-hydronalium KISHINATO) aluminum "Alq₃"; dopants, such as an acceptor and a donor, etc. may be added.

[0021]Another coating liquid for charge transport layer formation of the coating liquid for organic electroluminescence layer formation of this invention, A solvent is made to dissolve or distribute the material having contained both the precursor of a publicly known low molecule charge transporting material, a polymers charge transporting material, and a polymers charge transporting material, or a low molecule charge transporting material and a polymer material, and a leveling agent. Although each material is illustrated below, these do not limit this invention.

[0022]As a publicly known low molecule charge transporting material, TPD, NPD, an oxadiazole derivative, etc. are mentioned, for example. As a publicly known polymers charge transporting material, for example Poly aniline (PANI), 3,4-polyethylene dioxythiophene (PEDOT), polycarbazole (PVCz), poly (triphenylamine derivative) (Poly-TPD), poly (oxadiazole derivative) (Poly-OXZ), etc. are mentioned. As a precursor of a publicly known polymers charge transporting material, Pre-PPV, Pre-PNV, etc. are mentioned, for example. As a publicly known polymer material, PC, PMMA, PVCz, etc. are mentioned, for example.

[0023]Also in the charge transport layer which does not include a luminescent material, addition of a leveling agent is effective and as a leveling agent in such a case, A compound which was illustrated in the coating liquid for luminous layer formation is mentioned, and the leveling agent by Asahi Chemical Industry Co., Ltd. (trade name: S-145) can specifically be used conveniently. As for the addition, it is preferred to fill the expression of relations expressed with addition (wt%) <200 of L to the viscosity (cp) x

charge transporting material of L like a luminous layer. Usually, the addition of a leveling agent is 0.0001 – 30wt% to a charge transporting material, is 0.001 – 10wt% preferably, and is 0.1 – 5wt% more preferably.

[0024]It is preferred to use the solvent in which the steam pressure at the temperature at the time (at the time of transfer) of forming an organic layer contains at least one kind of solvent which is 500 Pa or less as a solvent used in order to dissolve or distribute a charge transporting material which was mentioned above. In order to realize still more preferably the viewpoint of membranous surface nature, and thickness which was suitable as an organic EL device, especially the solvent whose steam pressure is 250 Pa or less is preferred. the solvent whose steam pressure is 500 Pa or less when using the mixed solvent of two or more kinds of different solvents -- more than 50wt% -- containing is preferred. A solvent which the steam pressure at the temperature at the time of forming an organic layer illustrated in the coating liquid for luminous layer formation as a solvent which is 500 Pa or less is mentioned. In forming the organic electroluminescence medium which consists of a multilayer cascade screen, in order to prevent mixing of the material between the touching films, the solvent used for the layer formed behind has that preferred in which the layer currently formed previously is not dissolved.

[0025]To the coating liquid for charge transport layer formation, dopants, such as an additive agent for viscosity control which was illustrated in the coating liquid for luminous layer formation, an acceptor, and a donor, etc. may be added if needed.

[0026]The construction material of the 1st electrode 2 and the 2nd electrode 4 which pinches the organic electroluminescence medium 3 is selected by the composition of an organic electroluminescence display. Namely, when the substrate 1 is a transparent substrate and the 1st electrode is a transparent electrode in an organic electroluminescence display. Since luminescence from the organic electroluminescence medium 3 is emitted from the substrate 1 side, in order to raise luminous efficiency, it is preferred to provide a reflection film (not shown) in the field which uses the 2nd electrode 4 as a reflector, or does not adjoin the organic electroluminescence medium of the 2nd electrode 4. On the contrary, since luminescence from the organic electroluminescence medium 3 is emitted from the 2nd electrode 4 side when the 2nd electrode 4 is a transparent electrode, it is preferred to use the 1st electrode 2 as a reflector, or to provide a reflection film (not shown) between the 1st electrode 2 and the substrate 1.

[0027]As construction material of a transparent electrode, they are mentioned by CuI, ITO (indium stannic acid ghost), SnO_2 , ZnO, etc., and, for example as construction

material of a reflector, For example, alloys, such as metal, such as aluminum and calcium, magnesium silver, and lithium aluminum, Although the cascade screen of the metal like magnesium/silver, and magnesium/silver, the cascade screen of the insulator and metal like lithium fluoride/aluminum, etc. are mentioned, it is not limited to in particular these.

[0028]The 1st electrode or the 2nd electrode is formed on a substrate or an organic electroluminescence medium using the above-mentioned electrode material. The method in particular is not limited but dry processes, such as weld slag, EB vacuum evaporation, and resistance heating vacuum evaporation, are mentioned. The above-mentioned electrode material can be distributed in resin, and the 1st electrode or the 2nd electrode can also be formed by wet process, such as print processes and the ink jet method.

[0029]Next, arrangement of an organic EL device (pixel) is explained. The organic

electroluminescence display of this invention may comprise area with the luminescent color from which each portion of a display differs, for example as shown in drawing 2 (a). The stripe arrangement by which the red (R) emission pixel 8, the green (G) emission pixel 9, and the blue (B) emission pixel 10 as arrangement of a pixel indicated to be to drawing 2 (b) have been arranged at matrix form is mentioned. Arrangement of a pixel may be a mosaic array, a delta array, and the Square arrangement as shown in drawing 2 (c), 2 (d), and 2 (e), respectively. the R emission pixel 8, the G emission pixel 9, and the B emission pixel 10 -- it is not necessary to be necessarily 1:1:1, and as the rate of each occupation area is shown in drawing 2 (e), the occupation area of each pixel may be the same, or may change with each pixels.

[0030]It is preferred to provide a septum between pixels with the different luminescent color, in order to prevent mixture **** of a luminous layer. Layer structure or multilayer structure may be sufficient as a septum, it may be arranged between each pixel, and may be arranged between the different luminescent color. The thing insoluble to the solvent of the solvent which dissolved or distributed the luminescent material, the charge transporting material, and the polymer material, i.e., the coating liquid for luminous layer formation, and the coating liquid for charge transport layer formation, or refractory of the construction material of a septum is preferred. It is preferred especially to use the materials for black matrices (for example, chromium, resin black, etc.) in the meaning which raises the display quality as a display.

[0031]In order to prevent mixture **** of a luminous layer effectively as a septum, a thing with critical surface tension (γ [dyne/cm]) smaller than the surface tension of the coating liquid for organic electroluminescence layer formation is preferred. After forming a septum using material with small critical surface tension and specifically forming a septum, critical surface tension of a septum may be made small by performing plasma treatment, UV processing, gassing, etc.

[0032]As a desirable material for forming a septum, For example, poly 6 propylene fluoridation (γ =16 dyne/cm), poly ethylene tetrafluoride (γ =18 dyne/cm), Although what mixed KBM7103 (a trade name, the Shin-Etsu Chemical Co., Ltd. make, γ =20 dyne/cm) is mentioned into poly 3 ethylene fluoride (γ =22 dyne/cm) and a positive resist, it is not limited to in particular these.

[0033]Next, a connection method inter-electrode [corresponding to each pixel / 1st] and 2nd inter-electrode is explained. The organic electroluminescence display of this invention has the 1st electrode 2 or the 2nd good electrode 4 also as an electrode independent of each pixel, as shown in drawing 3 (a) for example. . [whether it is constituted so that the 1st electrode 2 and the 2nd electrode 4 which pinch an organic electroluminescence medium as shown in drawing 3 (b) may turn into an electrode of the stripe shape which intersects perpendicularly mutually on the common substrate 1, and] Or as shown in drawing 3 (c), the 1st electrode 2 or the 2nd electrode 4 may be connected to the common electrode via the thin film transistor (TFT) 11. 12 show a source bus line among a figure, and 13 shows a gate bus line, respectively.

[0034]Two or more pixels are arranged via the septum 5 at matrix form, and the full color display of the organic electroluminescence display of this invention becomes possible by giving two or more luminescent color to these pixels. As two or more luminescent color, red and green and blue combination are preferred.

[0035]Next, the formation method of the organic electroluminescence medium (organic

layer) by this invention is explained in detail. The manufacturing method of the organic EL device of this invention forms the organic layer of an organic EL device by the ink jet method or print processes using the coating liquid for organic electroluminescence layer formation of this invention. By the ink jet method or print processes, the coating liquid for formation for luminous layers is formed on the 1st electrode or a charge transport layer, and, specifically, the coating liquid for formation for charge transport layers is formed on the 1st electrode, a charge transport layer, or a luminous layer.

[0036]Although any a continuous type and on demand type may be sufficient as the ink jet method, the regurgitation method of liquid has a preferred piezo method, in order to prevent the coating liquid which dissolved or distributed the precursor of the organic luminescent material or the organic luminescent material deteriorating with heat. A dispenser and an ultrasonic spray are also contained in the ink jet of this invention.

[0037]Next, formation of the organic layer by the ink jet method is explained. As shown in drawing 4, an organic layer can be formed by carrying out the regurgitation of the coating liquid for organic electroluminescence layer formation with an inkjet printing method. When forming stroke matter, the regurgitation of only 1 liquid may be sufficient and the same place or a different place may be made to breathe out many liquid. As for the nozzle which carries out the regurgitation of the liquid about manufacture of organic LE display, it is preferred to use different nozzles for every luminescent color. It is preferred to use two or more nozzles with the same luminescent color in consideration of manufacture speed.

[0038]Next, formation of the organic layer by print processes is explained. Print processes are not limited in particular by the method of this invention, although the coating liquid for organic electroluminescence layer formation is attached to a transfer board, it is the method of transferring this coating liquid to a substrate and the conventional methods, such as Toppan Printing, intaglio printing, lithography, and offset printing, are mentioned. However, in order to form uniformly the thin film of 1 micrometer or less of thickness, Toppan Printing, intaglio printing, and lithography are preferred. Toppan Printing is preferred in order to form uniformly the thin film of 1000A or less of thickness furthermore.

[0039]As a structure of the printer used, as shown in drawing 5, to the transfer board 16 currently fixed to the roll part 17 which fixes the transfer board 16. It is supplied from the coating liquid entrance slot 14, and the coating liquid 18 is directly applied via the braid 15, Although it may transfer to the 1st electrode 2 on the substrate 1 installed on the stage 19, in order to make uniform thickness of the film formed in the substrate 1, As shown in drawing 6, it is preferred to apply the coating liquid 18 to the roll part 20 which holds coating liquid temporarily first, to transfer the roll part 20 to the transfer board 16 currently fixed to another roll part (roll part which fixes a transfer board) 17, and to transfer the transferred thing to the 1st electrode 2 on the substrate 1. As shown in drawing 7, the coating liquid 18 is first applied to the roll part 20 which holds coating liquid temporarily, The roll part 20 is transferred to another roll part (roll part which fixes a transfer board) 17, The coating liquid 18 furthermore transferred can be transferred to the transfer board 16 currently fixed to another roll part 21, the transferred coating liquid 18 can be transferred to the roll part 21 once again, and it can also transfer to the 1st electrode 2 on the substrate 1 after that.

[0040]The transfer board fixed to a roll part is explained. As for the construction material

of a transfer board, it is preferred to select according to the construction material of the substrate to be used. When a substrate is a resin substrate, the construction material of a transfer board may be any of a metallic material and a resin material, but when a substrate is an inorganic material board, the construction material of a transfer board has a preferred resin material in consideration of the damage to a substrate. This invention is not limited by these, although a copperplate etc. are mentioned and APR (a product name, the Asahi Chemical Co., Ltd. make) and Fuji TORERIFU (a product name, the Fuji Photo Film Co., Ltd. make) are mentioned as a resin material as a metallic material. As a transfer pattern, the concavo-convex pattern may be formed simply and the pattern may be formed in the wettable good portion and the bad portion to coating liquid (lithography may be sufficient).

[0041]When forming an organic layer by the ink jet method or print processes, environment in particular is not limited, but in consideration of moisture absorption of the formed film, and deterioration of organic materials, the inside of inactive gas is preferred.

[0042]It is preferred to perform stoving, in order to remove the solvent which remains, after forming an organic layer by the ink jet method or print processes. Although the environment in particular that dries is not limited, in consideration of moisture absorption of the formed film, and deterioration of organic materials, the inside of inactive gas is preferred, and the bottom of decompression is preferred.

[0043]

[Example]This invention is not limited by these examples although an example and a comparative example explain this invention still more concretely.

[0044]1 g of poly (dioctylfluorene) (PDF) as a <membrane formation test by printer> (comparative example 1) luminescent material is dissolved in 100 ml of trimethyl benzene (steam pressure at the temperature (28 **) at the time of forming an organic layer: 247 Pa), The viscosity of the coating liquid obtained by preparing the coating liquid for blue light stratification (surface tension: 27.8 mN/m) was measured. Next, the prepared coating liquid was transferred to the glass substrate using the ink jet device (nozzle diameter: 50 micrometers) and the Toppan Printing device (the 300 lines / inch as an ANIROKKU roll), and the film was produced. Printing pressure was 0.1 mm when printing, using APR (Shore A hardness 55) as a transfer board.

[0045]Surface nature was evaluated about the produced film. That is, 20 thickness of a film was measured at intervals of 5 mm, and the distribution and average value were calculated. The obtained result is shown in Table 1 with the viscosity of coating liquid.

[0046](Example 1) The quantity which is equivalent to 0.01wt% to PDF1g of a luminescent material as a leveling agent, That is, the coating liquid for blue light stratification was prepared like the comparative example 1 except adding 0.0001-g KF96L-1 (the product made from Shin-etsu Silicone, surface-tension:16.9 mN/m, the boiling point: 153 **) to the coating liquid for blue light stratification. The viscosity of the coating liquid before addition of a leveling agent was measured. The prepared coating liquid was transferred to the glass substrate like the comparative example 1, and surface nature was evaluated about the film obtained by producing a film. The obtained result is shown in Table 1 with the trade name of a leveling agent, an addition, viscosity, and the viscosity of the coating liquid before addition of a leveling agent.

[0047](Example 2) The quantity which is equivalent to 0.1wt% to PDF1g of a luminescent material as a leveling agent, i.e., 0.001-g KF96L-1, is added to the coating liquid for blue

light stratification, and instead of [of trimethyl benzene] -- the trimethyl benzene-xylene mixed solvent (steam pressure:trimethyl benzene 247Pa at the temperature (28 **) at the time of forming an organic layer.) of the mixture ratio 7:3 The coating liquid for blue light stratification was prepared like the comparative example 1 except using xylene 880Pa. The viscosity of the coating liquid before addition of a leveling agent was measured. The prepared coating liquid was transferred to the glass substrate like the comparative example 1, and surface nature was evaluated about the film obtained by producing a film. The obtained result is shown in Table 1 with the trade name of a leveling agent, an addition, viscosity, and the viscosity of the coating liquid before addition of a leveling agent.

[0048](Examples 3-5) As a leveling agent, to PDF1g of a luminescent material, respectively 1wt%, The coating liquid for blue light stratification was prepared like the comparative example 1 except adding the quantity equivalent to 10wt% and 20wt%, i.e., KF96L-1 [0.01g, 0.1g, andg / 0.2], to the coating liquid for blue light stratification. The viscosity of the coating liquid before addition of a leveling agent was measured. The prepared coating liquid was transferred to the glass substrate like the comparative example 1, and surface nature was evaluated about the film obtained by producing a film. The obtained result is shown in Table 1 with the trade name of a leveling agent, an addition, viscosity, and the viscosity of the coating liquid before addition of a leveling agent.

[0049](Examples 6-10) As a leveling agent, to PDF1g of a luminescent material, respectively 0.01wt%, 0. The quantity which is equivalent to 10wt% and 20wt% 1wt% 1wt%, KF96L-5 [namely, / 0.0001g, 0.001g, 0.01g 0.1g, andg / 0.2] (the product made from Shin-etsu Silicone.) Surface tension: The coating liquid for blue light stratification was prepared like the comparative example 1 except adding 19.7 mN/m and more than boiling point:200 ** to the coating liquid for blue light stratification. The viscosity of the coating liquid before addition of a leveling agent was measured. The prepared coating liquid was transferred to the glass substrate like the comparative example 1, and surface nature was evaluated about the film obtained by producing a film. The obtained result is shown in Table 1 with the trade name of a leveling agent, an addition, viscosity, and the viscosity of the coating liquid before addition of a leveling agent.

[0050](Comparative example 2) The quantity which is equivalent to 40wt% to PDF1g of a luminescent material as a leveling agent, That is, the coating liquid for blue light stratification was prepared like the comparative example 1 except adding 0.4-g KF96L-5 (the product made from Shin-etsu Silicone, surface-tension:19.7 mN/m, the boiling point: not less than 200 **) to the coating liquid for blue light stratification. The viscosity of the coating liquid before addition of a leveling agent was measured. The prepared coating liquid was transferred to the glass substrate like the comparative example 1, and surface nature was evaluated about the film obtained by producing a film. The obtained result is shown in Table 1 with the trade name of a leveling agent, an addition, viscosity, and the viscosity of the coating liquid before addition of a leveling agent.

[0051](Examples 11-14) As a leveling agent, to PDF1g of a luminescent material, respectively 0.01wt%, 0. The quantity which is equivalent to 1wt% and 10wt% 1wt%, i.e., 0.0001 g, The coating liquid for blue light stratification was prepared like the comparative example 1 except adding KF96L-10 [0.001g, 0.01g, andg / 0.1] (the product made from Shin-etsu Silicone, surface-tension:20.1 mN/m, the boiling point: not less than 200 **) to

the coating liquid for blue light stratification. The viscosity of the coating liquid before addition of a leveling agent was measured. The prepared coating liquid was transferred to the glass substrate like the comparative example 1, and surface nature was evaluated about the film obtained by producing a film. The obtained result is shown in Table 1 with the trade name of a leveling agent, an addition, viscosity, and the viscosity of the coating liquid before addition of a leveling agent.

[0052](Comparative example 3) The quantity which is equivalent to 20wt% to PDF1g of a luminescent material as a leveling agent, That is, the coating liquid for blue light stratification was prepared like the comparative example 1 except adding 0.2-g KF96L-10 (the product made from Shin-etsu Silicone, surface-tension:20.1 mN/m, the boiling point: not less than 200 **) to the coating liquid for blue light stratification. The viscosity of the coating liquid before addition of a leveling agent was measured. The prepared coating liquid was transferred to the glass substrate like the comparative example 1, and surface nature was evaluated about the film obtained by producing a film. The obtained result is shown in Table 1 with the trade name of a leveling agent, an addition, viscosity, and the viscosity of the coating liquid before addition of a leveling agent.

[0053](Examples 15-18) As a leveling agent, to PDF1g of a luminescent material, respectively 0.001wt%, 0. The quantity which is equivalent to 0.1wt% and 1wt% 01wt%, i.e., 0.00001 g, The coating liquid for blue light stratification was prepared like the comparative example 1 except adding KF96L-100 [0.0001g, 0.001g, andg / 0.01] (the product made from Shin-etsu Silicone, surface-tension:20.9 mN/m, the boiling point: not less than 200 **) to the coating liquid for blue light stratification. The viscosity of the coating liquid before addition of a leveling agent was measured. The prepared coating liquid was transferred to the glass substrate like the comparative example 1, and surface nature was evaluated about the film obtained by producing a film. The obtained result is shown in Table 1 with the trade name of a leveling agent, an addition, viscosity, and the viscosity of the coating liquid before addition of a leveling agent.

[0054](Comparative example 4) The quantity which is equivalent to 2wt% to PDF1g of a luminescent material as a leveling agent, That is, the coating liquid for blue light stratification was prepared like the comparative example 1 except adding 0.02-g KF96L-100 (the product made from Shin-etsu Silicone, surface-tension:20.9 mN/m, the boiling point: not less than 200 **) to the coating liquid for blue light stratification. The viscosity of the coating liquid before addition of a leveling agent was measured. The prepared coating liquid was transferred to the glass substrate like the comparative example 1, and surface nature was evaluated about the film obtained by producing a film. The obtained result is shown in Table 1 with the trade name of a leveling agent, an addition, viscosity, and the viscosity of the coating liquid before addition of a leveling agent.

[0055]1 g of the 3,4-polyethylene dioxythiophene (PEDOT) / polystyrene SARUFONETO as comparative example 5 hole transporting material (PSS), It dissolved in 100 ml of pure water-ethylene glycol mixed solutions (steam pressure at the temperature at the time of forming an organic layer: 7 Pa, surface tension:53.3 mN/m) of the mixture ratio 6:4, and the viscosity of the coating liquid obtained by preparing the coating liquid for electron hole transporting bed formation was measured. Next, the prepared coating liquid was transferred to the glass substrate using the thing which converted the commercial ink jet printer, and the Toppan Printing device (the 300 lines / inch as an ANIROKKU roll), and the film was produced. Printing pressure was 0.1 mm when printing, using APR (Shore A

hardness 55) as a transfer board.

[0056]Surface nature was evaluated about the produced film. That is, 20 thickness of a film was measured at intervals of 5 mm, and the distribution and average value were calculated. The obtained result is shown in Table 1 with the viscosity of coating liquid.

[0057](Example 19) The quantity which is equivalent to 0.01wt% to PEDOT/PSS 1g of a hole transporting material as a leveling agent, Namely, the thing for which S-145 [0.0001-g] (the Asahi Chemical Industry Co., Ltd. make, surface tension:16.5 mN/m) is added to the coating liquid for electron hole transporting bed formation, instead of [of a pure water-ethylene glycol mixed solution] -- the methanol ethylene glycol mixed solvent (:methanol 12300Pa at the temperature at the time of forming an organic layer.) of the mixture ratio 6:4 The coating liquid for electron hole transporting bed formation was prepared like the comparative example 5 except using ethylene glycol 7Pa. The viscosity of the coating liquid before addition of a leveling agent was measured. The prepared coating liquid was transferred to the glass substrate like the comparative example 5, and surface nature was evaluated about the film obtained by producing a film. The obtained result is shown in Table 1 with the trade name of a leveling agent, an addition, viscosity, and the viscosity of the coating liquid before addition of a leveling agent.

[0058](Examples 20-23) As a leveling agent, to PEDOT/PSS 1g of a hole transporting material, respectively 0.1wt%, The coating liquid for electron hole transporting bed formation was prepared like the comparative example 5 except adding the quantity equivalent to 10wt% and 20wt%, i.e., S-145 [0.001g, 0.01g, 0.1g, andg / 0.2], to the coating liquid for electron hole transporting bed formation 1wt%. The viscosity of the coating liquid before addition of a leveling agent was measured. The prepared coating liquid was transferred to the glass substrate like the comparative example 5, and surface nature was evaluated about the film obtained by producing a film. The obtained result is shown in Table 1 with the trade name of a leveling agent, an addition, viscosity, and the viscosity of the coating liquid before addition of a leveling agent.

[0059](Comparative example 6) The coating liquid for electron hole transporting bed formation was prepared like the comparative example 5 except adding the quantity which is equivalent to 30wt% to PEDOT/PSS 1g of a hole transporting material as a leveling agent, i.e., S-145 [0.3-g], to the coating liquid for electron hole transporting bed formation. The viscosity of the coating liquid before addition of a leveling agent was measured. The prepared coating liquid was transferred to the glass substrate like the comparative example 5, and surface nature was evaluated about the film obtained by producing a film. The obtained result is shown in Table 1 with the trade name of a leveling agent, an addition, viscosity, and the viscosity of the coating liquid before addition of a leveling agent.

[0060]

[Table 1]

[Table 1]

Comparative Example 1
Example 1
Example 2
Example 3
Example 4
Example 5
Example 6
Example 7
Example 8
Example 9
Example 10
Comparative Example 2
Example 11
Example 12
Example 13
Example 14
Comparative Example 3
Example 15
Example 16
Example 17
Example 18
Comparative Example 4
Comparative Example 5
Example 19
Example 20
Example 21
Example 22
Example 23
Comparative Example 6

- (1) Viscosity of coating liquid before
blending of leveling agent
- (2) Leveling agent
- (3) Product code
- (4) Blending Amount
- (5) Viscosity
- (6) Ink jet method
- (7) Thickness
- (8) Average
- (9) Distribution
- (10) Print process
- (11) Thickness
- (12) Average
- (13) Distribution

	塗液 粘度 1) (1)	レベリング剤 (2)			インジエクト法(6)		印刷法(10)	
		商品名(3)	添加量(4)	粘度(5)	膜厚 (7)		膜厚 (11)	
					平均(8)	分布(9)	平均(12)	分布(13)
比較例 1	2.6cp	—	—	—	828	630~1030	708	610~960
実施例 1	2.6cp	KF96L-1	0.01wt%	1cp	1099	960~1240	1008	870~1120
実施例 2	2.6cp	KF96L-1	0.1wt%	1cp	1130	1050~1190	1020	920~1070
実施例 3	2.6cp	KF96L-1	1wt%	1cp	1130	1055~1150	1010	950~1050
実施例 4	2.6cp	KF96L-1	10wt%	1cp	1145	1073~1130	1035	970~1027
実施例 5	2.6cp	KF96L-1	20wt%	1cp	1104	1057~1124	1002	960~1020
実施例 6	2.6cp	KF96L-5	0.01wt%	5cp	1105	1074~1115	1012	973~1020
実施例 7	2.6cp	KF96L-5	0.1wt%	5cp	1118	1023~1129	1023	926~1036
実施例 8	2.6cp	KF96L-5	1wt%	5cp	1124	1048~1155	1014	953~1052
実施例 9	2.6cp	KF96L-5	10wt%	5cp	1134	1064~1132	1032	972~1037
実施例 10	2.6cp	KF96L-5	20wt%	5cp	1126	1053~1162	1023	963~1046
比較例 2	2.6cp	KF96L-5	40wt%	5cp	1123	1058~1163	1025	970~1050
実施例 11	2.6cp	KF96L-10	0.01wt%	10cp	1118	1072~1205	1014	970~1111
実施例 12	2.6cp	KF96L-10	0.1wt%	10cp	1124	1022~1184	1021	920~1070
実施例 13	2.6cp	KF96L-10	1wt%	10cp	1123	1067~1134	1020	953~1022
実施例 14	2.6cp	KF96L-10	10wt%	10cp	1113	1082~1121	1018	987~1017
比較例 3	2.6cp	KF96L-10	20wt%	10cp	1109	1076~1125	1009	974~1020
実施例 15	2.6cp	KF96L-100	0.001wt%	100cp	1112	1052~1227	1011	957~1120
実施例 16	2.6cp	KF96L-100	0.01wt%	100cp	1098	1034~1174	1017	920~1070
実施例 17	2.6cp	KF96L-100	0.1wt%	100cp	1103	1047~1149	1007	963~1052
実施例 18	2.6cp	KF96L-100	1wt%	100cp	1115	1073~1121	1012	970~1024
比較例 4	2.6cp	KF96L-100	2wt%	100cp	1123	1045~1125	1021	965~1022
比較例 5	4.2cp	—	—	—	523	470~734	422	370~638
実施例 19	4.2cp	S-145	0.01wt%	8.3cp	633	589~686	530	496~576
実施例 20	4.2cp	S-145	0.1wt%	8.3cp	622	589~674	524	492~563
実施例 21	4.2cp	S-145	1wt%	8.3cp	635	574~667	532	484~566
実施例 22	4.2cp	S-145	10wt%	8.3cp	627	593~643	517	492~553
実施例 23	4.2cp	S-145	20wt%	8.3cp	631	594~638	534	491~548
比較例 6	4.2cp	S-145	30wt%	8.3cp	628	586~640	528	499~550

¹⁾ レベリング剤添加前

[0061] By making coating liquid contain the leveling agent which consists of a silicon system compound or a fluorine system compound from the result of Table 1 shows that the membranous surface can be made flat.

[0062] (Comparative example 7) The pattern electrodes which consist the glass substrate with ITO of 150 nm of thickness of 2-mm-wide ITO in the pitch of 4 mm as the 1st electrode with photolithography method were formed. Next, the conventional wet process (isopropyl alcohol, acetone, and pure water) washed this substrate, and the further conventional dry process (UV ozonization and plasma treatment) washed it. On the glass substrate with ITO, PEDOT/PSS solution was used, the electron hole transporting bed of 50 nm of thickness was formed with the spin coat method, and stoving was carried out for 5 minutes at 200 °C under a nitrogen atmosphere.

[0063] PDF1g as a luminescent material was dissolved in 100 ml of trimethyl benzene, and the coating liquid for blue light stratification was prepared. Subsequently, using the coating liquid prepared on the glass substrate with ITO in which the electron hole transporting bed was formed, the blue light layer of 50 nm of thickness was formed with the spin coat method, and stoving was carried out at 160 °C under a nitrogen atmosphere.

for 2 hours. Next, the shadow mask as for which the hole of 2 mm x 100-mm width was vacant was fixed to the direction which intersects perpendicularly with this substrate with previous ITO, it put into the vacuum evaporator, 300-nm vacuum deposition of 50 nm and Ag was carried out for Ca under the vacuum of 1×10^{-6} Torr, and it was considered as the 2nd electrode (confrontation electrode).

[0064]About the produced element, the electrical property (luminosity of 10V, cd/m^2) and the reduction-by-half life (initial 100 cd/m^2) were evaluated. The obtained result is shown in Table 2.

[0065](Comparative example 8) The pattern electrodes which consist the glass substrate with ITO of 150 nm of thickness of 2-mm-wide ITO in the pitch of 4 mm as the 1st electrode with photolithography method were formed. Next, the conventional wet process (isopropyl alcohol, acetone, and pure water) washed this substrate, and the further conventional dry process (UV ozonization and plasma treatment) washed it. On the glass substrate with ITO, PEDOT/PSS solution was used, the electron hole transporting bed of 50 nm of thickness was formed with the spin coat method, and stoving was carried out for 5 minutes at 200 °C under a nitrogen atmosphere.

[0066]PDF1g as a luminescent material was dissolved in 100 ml of trimethyl benzene, and the coating liquid for blue light stratification was prepared. Subsequently, the coating liquid prepared on the glass substrate with ITO in which the electron hole transporting bed was formed is transferred using an ink jet device (nozzle diameter: 20 micrometers) and the Toppan Printing device (ANIROKKU roll: 300 lines / inch), The blue light layer of 50 nm of thickness was formed, and stoving was carried out at 160 °C under a nitrogen atmosphere for 2 hours. Next, the shadow mask as for which the hole of 2 mm x 100-mm width was vacant was fixed to the direction which intersects perpendicularly with this substrate with previous ITO, it put into the vacuum evaporator, 300-nm vacuum deposition of 50 nm and Ag was carried out for Ca under the vacuum of 1×10^{-6} Torr, and it was considered as the 2nd electrode (confrontation electrode).

[0067]About the produced element, the electrical property (luminosity of 10V, cd/m^2) and the reduction-by-half life (initial 100 cd/m^2) were evaluated. The obtained result is shown in Table 2.

[0068](Examples 24-33) The element was produced like the comparative example 8 except using the coating liquid prepared in Examples 1-10 as coating liquid for blue light stratification, respectively. The electrical property and the reduction-by-half life were evaluated about the produced element like the comparative example 8. The obtained result is shown in Table 2.

[0069](Comparative example 9) The element was produced like the comparative example 8 except using the coating liquid prepared by the comparative example 2 as coating liquid for blue light stratification. The electrical property and the reduction-by-half life were evaluated about the produced element like the comparative example 8. The obtained result is shown in Table 2.

[0070](Examples 34-37) The element was produced like the comparative example 8 except using the coating liquid prepared in Examples 11-14 as coating liquid for blue light stratification, respectively. The electrical property and the reduction-by-half life were evaluated about the produced element like the comparative example 8. The obtained

result is shown in Table 2.

[0071](Comparative example 10) The element was produced like the comparative example 8 except using the coating liquid prepared by the comparative example 3 as coating liquid for blue light stratification. The electrical property and the reduction-by-half life were evaluated about the produced element like the comparative example 8. The obtained result is shown in Table 2.

[0072](Examples 38-41) The element was produced like the comparative example 8 except using the coating liquid prepared in Examples 15-18 as coating liquid for blue light stratification, respectively. The electrical property and the reduction-by-half life were evaluated about the produced element like the comparative example 8. The obtained result is shown in Table 2.

[0073](Comparative example 11) The element was produced like the comparative example 8 except using the coating liquid prepared by the comparative example 4 as coating liquid for blue light stratification. The electrical property and the reduction-by-half life were evaluated about the produced element like the comparative example 8. The obtained result is shown in Table 2.

[0074](Comparative example 12) The pattern electrodes which consist the glass substrate with ITO of 150 nm of thickness of 2-mm-wide ITO in the pitch of 4 mm as the 1st electrode with photolithography method were formed. Next, the conventional wet process (isopropyl alcohol, acetone, and pure water) washed this substrate, and the further conventional dry process (UV ozonization and plasma treatment) washed it. PEDOT/PSS 1g was dissolved in 100 ml of methanol ethylene glycol mixed solvents of the mixture ratio 6:4, and the coating liquid for electron hole transporting bed formation was prepared. Subsequently, the coating liquid prepared on the glass substrate with ITO was transferred using the ink jet device (nozzle diameter: 20 micrometers) and the Toppan Printing device (ANIROKKU roll: 300 lines / inch), and the electron hole transporting bed of 50 nm of thickness was formed.

[0075]PDF1g as a luminescent material was dissolved in 100 ml of trimethyl benzene, and the coating liquid for blue light stratification was prepared. Subsequently, the blue light layer of 50 nm of thickness was formed on the glass substrate with ITO in which the electron hole transporting bed was formed, with the spin coat method. Next, the shadow mask as for which the hole of 2 mm x 100-mm width was vacant was fixed to the direction which intersects perpendicularly with this substrate with previous ITO, it put into the vacuum evaporator, 300-nm vacuum deposition of 50 nm and Ag was carried out for Ca under the vacuum of 1×10^{-6} Torr, and it was considered as the 2nd electrode (counterelectrode). The electrical property and the reduction-by-half life were evaluated about the produced element like the comparative example 8. The obtained result is shown in Table 2.

[0076](Examples 42-46) The element was produced like the comparative example 8 except using the coating liquid prepared in Examples 19-23 as coating liquid for blue light stratification, respectively. The electrical property and the reduction-by-half life were evaluated about the produced element like the comparative example 8. The obtained result is shown in Table 2.

[0077](Comparative example 13) The element was produced like the comparative example 8 except using the coating liquid prepared by the comparative example 6 as coating liquid for blue light stratification. The electrical property and the reduction-by-half life were

evaluated about the produced element like the comparative example 8. The obtained result is shown in Table 2.

[0078]

[Table 2]

	インクジェット法		印刷法	
	電気的特性	半減寿命	電気的特性	半減寿命
	10Vでの輝度 (cd/m ²)	初期 100cd/m ² (h)	10Vでの輝度 (cd/m ²)	初期 100cd/m ² (h)
比較例 7	430 ²⁾	250 ²⁾	430 ²⁾	250 ²⁾
比較例 8	47	10	20	14
実施例 2 4	450	240	430	250
実施例 2 5	460	250	440	250
実施例 2 6	420	240	440	250
実施例 2 7	410	230	420	230
実施例 2 8	420	230	440	240
実施例 2 9	440	250	430	250
実施例 3 0	460	250	420	250
実施例 3 1	450	240	440	240
実施例 3 2	440	220	450	230
実施例 3 3	420	180	460	190
比較例 9	110	95	128	40
実施例 3 4	430	250	430	250
実施例 3 5	410	240	440	250
実施例 3 6	450	250	420	250
実施例 3 7	420	190	440	190
比較例 1 0	210	50	230	40
実施例 3 8	420	250	430	250
実施例 3 9	450	240	440	240
実施例 4 0	440	230	420	220
実施例 4 1	430	180	440	190
比較例 1 1	4	40	2	30
比較例 1 2	50	46	57	34
実施例 4 2	440	260	440	270
実施例 4 3	430	250	440	260
実施例 4 4	440	240	430	250
実施例 4 5	420	250	440	260
実施例 4 6	390	220	370	220
比較例 1 3	12	20	3	24

2) スピンコート法により膜形成を行った。

[0079] By making coating liquid contain the leveling agent which consists of a silicon system compound or a fluorine system compound from the result of Table 2, It turns out that the film formed by the ink jet method or print processes can solve the problem that luminous efficiency and a life fall compared with the film formed by the spin coat method. It turns out that the following fixed relations between the viscosity of a leveling agent and the addition which does not cause the fall of luminous efficiency or a life are. Addition (wt%) <200 of L to the viscosity (cp) x luminescent material or charge transporting material of L, i.e., a leveling agent with lower viscosity, can be added abundant, and the fall of luminous efficiency or a life can be prevented by filling the

above-mentioned expression of relations.

[0080](Example 47) With photolithography method, the 100-micrometer-wide ITO transparent stripe electrode was formed for the glass substrate with ITO of 130 nm of thickness by pitch 120micrometer as the 1st electrode. Next, the conventional wet process (isopropyl alcohol, acetone, and pure water) washed this substrate, and the further conventional dry process (UV ozonization and plasma treatment) washed it.

[0081]Next, the coat of the negative-mold photopolymer which contains the surface tension regulator (the Asahi Glass [Co., Ltd.] make, a trade name: SAITOPPU CTL) of critical-surface-tension 10 dyne/cm on this substrate was carried out so that it might become 4 micrometers of thickness with a spin coat method. Next, mask exposure was carried out, the residue of the resist film was flushed, and the 40-micrometer-wide septum was obtained by pitch 120micrometer in the direction which intersects perpendicularly in the direction which is parallel to ITO with pitch 300micrometer and ITO.

[0082]Next, using the ink jet device (nozzle diameter: 20 micrometers), each pixel was made to breathe out the coating liquid for electron hole transporting bed formation of the PEDOT/PSS solution of surface tension 40 dyne/cm, stoving was continuously carried out for 30 minutes at 90 ** under the vacuum, and the electron hole transporting bed of 75 nm of thickness was formed.

[0083]An ink jet device is used, As opposed to the poly[bis[2,5-] (hexyloxy 1,4-phenylene)] (1-cyanovinylene) precursor (Pre-CN-PPV) and this luminescent material as a red light material. 0. leveling agent KF96L-1 of the quantity equivalent to 1wt% -- the methanol diethylene-glycol mixed solvent (:methanol 12300Pa at the temperature at the time of forming an organic layer.) of the mixture ratio 4:6 The coating liquid for red light stratification dissolved in diethylene-glycol 2Pa, Leveling agent of the quantity which is equivalent to 0.1wt% to the poly (p-phenylenevinylene) precursor (Pre-PPV) and this luminescent material as a green emission material Coating liquid for green emission stratification which dissolved KF96L-1 in the methanol ethylene glycol mixed solvent of the mixture ratio 6:4, And leveling agent of the quantity which is equivalent to 0.1wt% to poly (dioctylfluorene) (PDF) as a blue light material, and this luminescent material Patterning spreading of the coating liquid for blue light stratification which dissolved KF96L-1 in trimethyl benzene was carried out. The surface tension of each used coating liquid was 30 dyne/cm.

[0084]Stoving of these was carried out after coat formation, and the luminous layer of 110 nm of thickness was obtained. About the coat containing PDF, stoving was carried out at 100 ** for 1 hour. About Pre-CN-PPV and a Pre-PPV **** coat, it heat-treated at 150 ** under Ar atmosphere for 6 hours, and changed into CN-PPV and PPV simultaneously with desiccation, respectively. Since each coating liquid for luminous layer formation of NURE nature was bad to the septum so that clearly also from the relation between the critical surface tension of a septum, and the surface tension of each coating liquid for luminous layer formation, mixture **** of the luminous layer between emission pixels with the different luminescent color was able to be prevented effectively.

[0085]Next, using the 0.2-micrometer [in thickness], 270-micrometer [in width], and pitch 300nm shadow mask, vapor codeposition of aluminum and the Li was carried out, and the AlLi alloy electrode as the 2nd electrode was formed. The element obtained at the end was closed using the epoxy resin, and the organic electroluminescence display

was produced.

[0086]When the pulse voltage of 30V was impressed to the organic EL device produced by making it above and the luminescent state was observed, luminescence was obtained from all the pixels, the short circuit the 1st electrode, inter-electrode [2nd], inter-electrode [1st], and 2nd inter-electrode was not generated, and the mixed colors depended to mix a luminous layer were not observed. The unevenness of luminescence within the pixel by the unevenness of the thickness of a luminous layer and a charge transport layer was not observed.

[0087](Example 48) With photolithography method, the 100-micrometer-wide ITO transparent stripe electrode was formed for the glass substrate with ITO of 130 nm of thickness by pitch 120micrometer as the 1st electrode. Next, the conventional wet process (isopropyl alcohol, acetone, and pure water) washed this substrate, and the further conventional dry process (UV ozonization and plasma treatment) washed it.

[0088]Next, the coat of the negative-mold photopolymer which contains the surface tension regulator (the Asahi Glass [Co., Ltd.] make, a trade name: SAITOPPU CTL) of critical-surface-tension 10 dyne/cm on this substrate was carried out so that it might become 4 micrometers of thickness with a spin coat method. Next, mask exposure was carried out, the residue of the resist film was flushed, and the 40-micrometer-wide septum was obtained by pitch 120micrometer in the direction which intersects perpendicularly in the direction which is parallel to ITO with pitch 300micrometer and ITO.

[0089]Next, using the Toppan Printing device (ANIROKKU roll: 300 lines / inch), the coating liquid for electron hole transporting bed formation of PEDOT/PSS solution with a surface tension of 40 dynes/cm was transferred, stoving was continuously carried out for 30 minutes at 90 ** under the vacuum, and the electron hole transporting bed of 75 nm of thickness was formed.

[0090]Leveling agent of the quantity which is equivalent to 0.1wt% to Pre-CN-PPV and this luminescent material as a red light material using the Toppan Printing device Coating liquid for red light stratification which dissolved KF96L-1 in the methanol diethylene-glycol mixed solvent of the mixture ratio 6:4, Leveling agent of the quantity which is equivalent to 0.1wt% to Pre-PPV and this luminescent material as a green emission material Coating liquid for green emission stratification which dissolved KF96L-1 in the methanol ethylene glycol mixed solvent of the mixture ratio 6:4, And leveling agent of the quantity which is equivalent to 0.1wt% to PDF as a blue light material, and this luminescent material Patterning spreading of the coating liquid for blue light stratification which dissolved KF96L-1 in trimethyl benzene was carried out. The surface tension of each used coating liquid was 30 dyne/cm.

[0091]Stoving of these was carried out after coat formation, and the luminous layer of 110 nm of thickness was obtained. About the coat containing PDF, stoving was carried out at 100 ** for 1 hour. About Pre-CN-PPV and a Pre-PPV **** coat, it heat-treated at 150 ** under Ar atmosphere for 6 hours, and changed into CN-PPV and PPV simultaneously with desiccation, respectively. Since each coating liquid for luminous layer formation of NURE nature was bad to the septum so that clearly also from the relation between the critical surface tension of a septum, and the surface tension of each coating liquid for luminous layer formation, mixture **** of the luminous layer between emission pixels with the different luminescent color was able to be prevented effectively.

[0092]Next, using the 0.2-micrometer [in thickness], 270-micrometer [in width], and pitch 300nm shadow mask, vapor codeposition of aluminum and the Li was carried out, and the AlLi alloy electrode as the 2nd electrode was formed. The element obtained at the end was closed using the epoxy resin, and the organic electroluminescence display was produced.

[0093]When the pulse voltage of 30V was impressed to the organic EL device produced by making it above and the luminescent state was observed, luminescence was obtained from all the pixels, the short circuit the 1st electrode, inter-electrode [2nd], inter-electrode [1st], and 2nd inter-electrode was not generated, and the mixed colors depended to mix a luminous layer were not observed. The unevenness of luminescence within the pixel by the unevenness of the thickness of a luminous layer and a charge transport layer was not observed.

[0094]
[Effect of the Invention]It becomes possible to form the organic layer which was excellent in surface smoothness by the ink jet method or print processes according to this invention, and it becomes possible to manufacture cheaply the organic EL device which was excellent in luminous efficiency and in which a colored presentation is possible, and an organic electroluminescence display.

[Translation done.]

*** NOTICES ***

JPO and INPIT are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is an outline sectional view of the organic EL device of this invention.

[Drawing 2]It is an outline part plan of arrangement of the luminous layer of the organic electroluminescence display of this invention.

[Drawing 3]It is an outline part plan of arrangement of the electrode of the organic electroluminescence display of this invention.

[Drawing 4]It is a schematic diagram of the formation process of the luminous layer by the inkjet method in the organic electroluminescence display of this invention.

[Drawing 5]It is an outline fragmentary sectional view of the printer of the organic electroluminescence display of this invention.

[Drawing 6]It is an outline fragmentary sectional view of the printer of the organic electroluminescence display of this invention.

[Drawing 7]It is an outline fragmentary sectional view of the printer of the organic electroluminescence display of this invention.

[Description of Notations]

- 1 Substrate
- 2 The 1st electrode
- 3 Organic electroluminescence medium (organic layer)
- 4 The 2nd electrode
- 5 Septum
- 6 A sealing film or a sealing substrate
- 7 Deflection plate
- 8 Red (R) emission pixel
- 9 Green (G) emission pixel
- 10 Blue (B) emission pixel
- 11 Thin film transistor (TFT)
- 12 Source bus line
- 13 Gate bus line
- 14 Coating liquid entrance slot
- 15 Braid
- 16 Transfer board
- 17 The roll part which fixes a transfer board
- 18 Coating liquid

19 X-Y stage

20 The roll part which holds coating liquid temporarily (anilox roll)

21 Roll part

22 Inkjet printer head

[Translation done.]

* NOTICES *

JPO and INPIT are not responsible for any damages caused by the use of this translation.

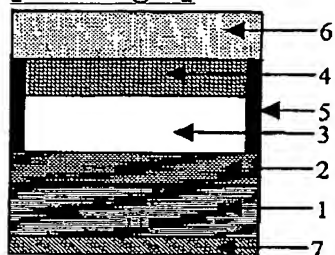
1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.*** shows the word which can not be translated.

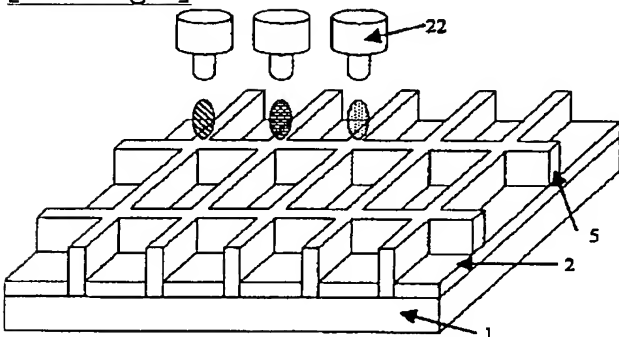
3.In the drawings, any words are not translated.

DRAWINGS

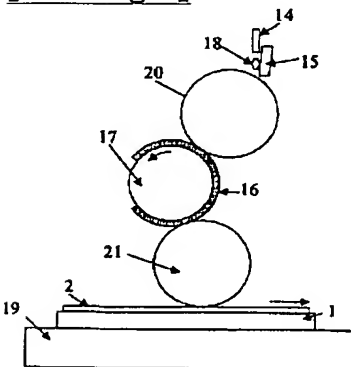
[Drawing 1]



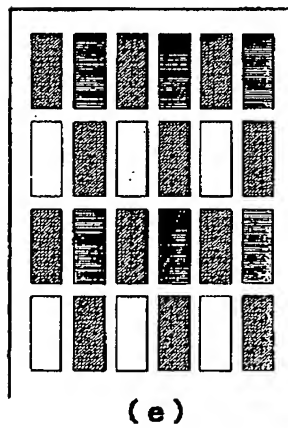
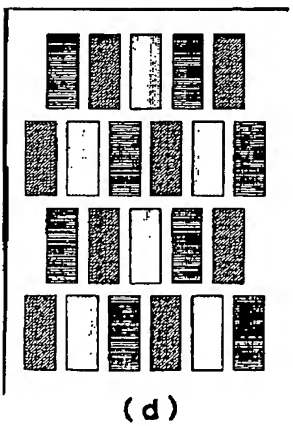
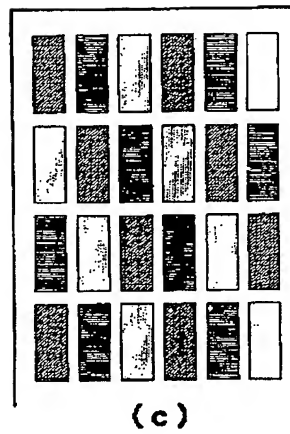
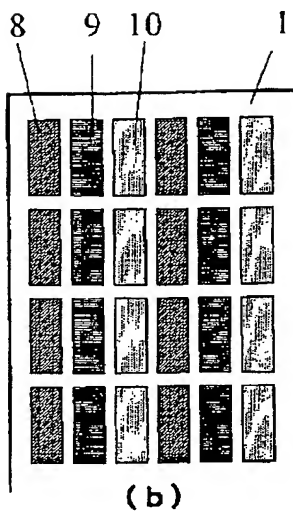
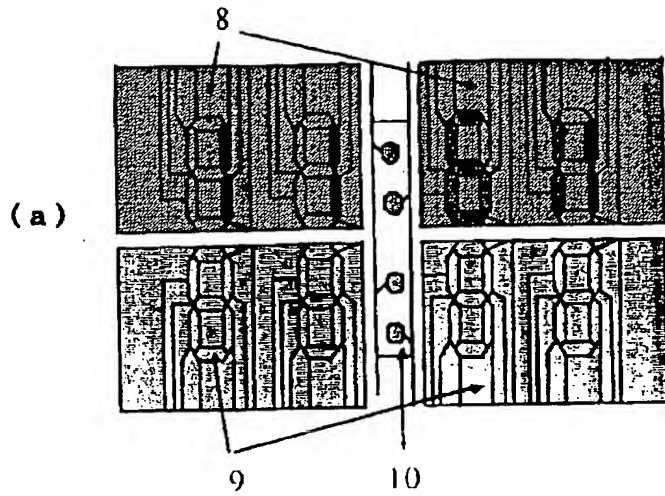
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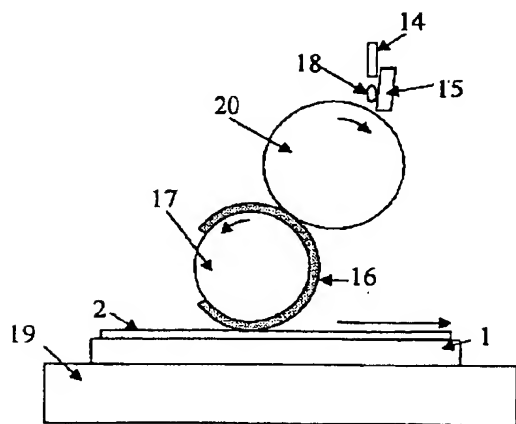
[Drawing 7]



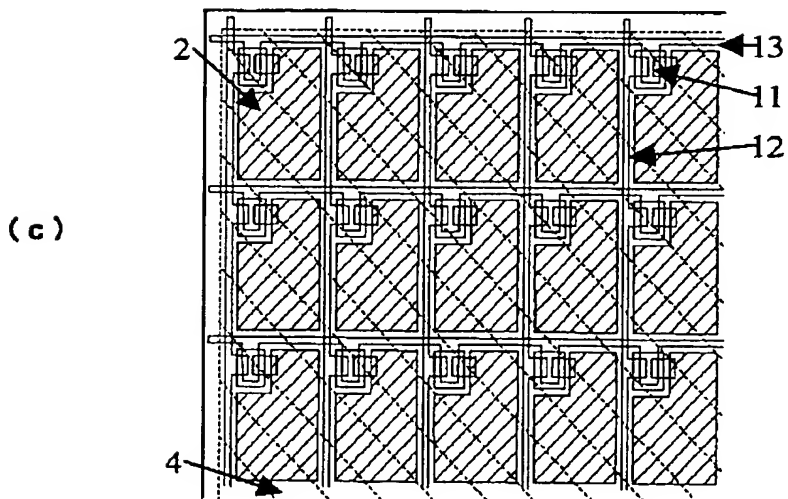
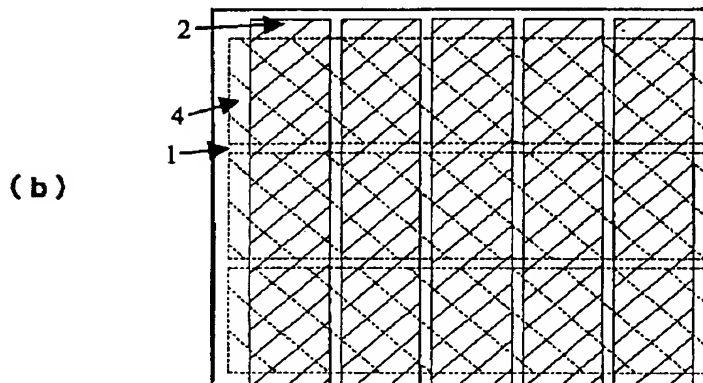
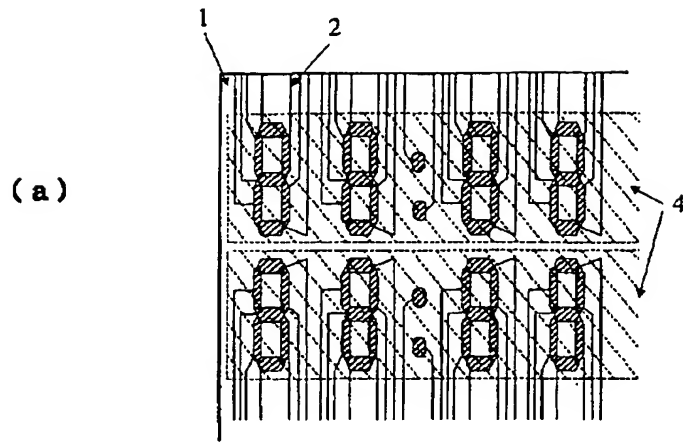
[Drawing 2]



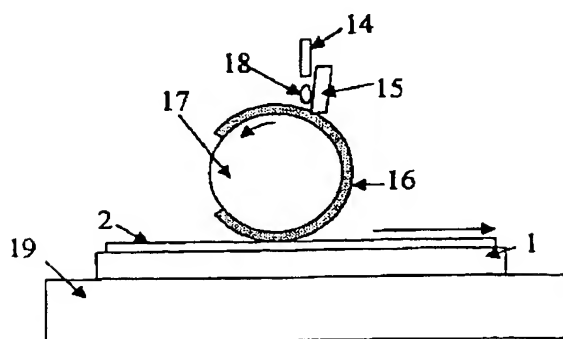
[Drawing 6]



[Drawing 3]



[Drawing 5]



[Translation done.]